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AUTHOR Ultan, Russell
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SOME REFLECTIONS ON VOWEL HARMONY

Russell Ultan
Language Universals Project

ABSTRACT

Conditions favoring the development of the three major types of vowel-harmony systems: horizontal, palatal and labial are examined in terms of correlations between sonority, contiguity, or phonetic distance on the one hand and relative assimilability of vowels on the other. Broadly speaking, the less sonorous, the more contiguous, and the closer the vowel is in terms of articulatory features, the more likely it is to assimilate to the determining vowel. Investigation of the relative markedness of harmonic grades shows that the feature values: tense, low, front, and unrounded, are unmarked vis-à-vis their respective marked counterparts: lax, high, back, and rounded, leading to the conclusion that marked feature values tend to assimilate to the corresponding unmarked values. Among the three primary dimensions, labiality is most marked, then palatality, followed by the least marked, horizontality. Neutral vowels are also briefly discussed.

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1. Introduction

The purpose of the present paper is to examine a number of vowel harmony systems and some other related kinds of vocalic assimilation, notably umlaut, in an effort to determine:

1) those general conditions or factors that favor the development of vowel harmony;

2) those that disfavor or interfere with it and tend to result in the disintegration of such systems.

In the process, various formal types of vowel harmony and their interrelations will be discussed along with some reference to certain types of consonant harmony associated with vowel harmony.

Collinder (1965: 64-5) uses the general term metaphony to encompass umlaut and vowel harmony.[1] Traditionally, umlaut refers to partial, always regressive assimilation of vowel to vowel, the affected vowel being typically in a "weak" position (usually unstressed and/or word-final), while vowel harmony has often -- but far from always -- been used to refer to the same, but progressive, assimilation. However, this association of specific direction (progressive) with vowel harmony is due merely to historical accident. Since vowel harmony happens to be particularly widespread in early-described ALTAIC (especially TURKIC) and URALIC languages, which are entirely or primarily suffixing languages, and since it is almost always the stem vowel that determines the shape of the harmonic vowel, the direction of assimilation in those languages is progressive. But in reality, directionality cannot be used as a defining feature in analyzing vowel harmony systems (see also Aoki, 1968: 145). Except for the fact that vowel harmony usually implies uniform assimilation of all the vowels of a given grammatical unit (which can be likened to a chain reaction) whereas umlaut ordinarily involves only two vowels, the two terms actually refer to the same phenomenon, partial vocalic assimilation induced by neighboring vowels. This can be easily demonstrated in languages like MORU, IBO, and NEZ PERCE where stem vowels affect both prefixes and suffixes in exactly the same way thus resulting in both (sometimes simultaneously) progressive and regressive assimilation. Therefore investigation of vowel harmony cannot arbitrarily be separated from that of umlaut.

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[1] "Metaphony means, from a descriptive point of view, that there is, to some extent, an interdependence between the qualities of the vowels of different syllables of the same word. Historically, it means that the quality of one vowel has influenced the quality of another vowel ... Metaphony may be progressive ... or regressive, or reciprocal. Progressive metaphony is usually called vowel harmony, and regressive metaphony, frequent in the Germanic languages (except Gothic), is called umlaut."

An examination of what has been referred to as vowel harmony in a number of different languages indicates that the following features are characteristic of all of them:

1) The determiner is a vowel.[2] This perhaps obvious consideration receives additional support from the fact that in languages with both vowel and associated consonant harmony, evidence for the origin of the latter invariably indicates that it is a product of the former.[3] This is true, for example, in many TURKIC languages and MONGOLIAN where velar consonant harmony is a later development than the palatal vowel harmony that produced it, and also in the KONDA dialects of VOGUL where the only traces of URALIC vowel harmony are to be found in an alternation of velar and postvelar stops and spirants in certain suffixes.

2) The determiner is generally a root or stem vowel (or vowels) but other factors may intervene, overriding the dominant effect of stem vowels. Thus, in LHASA TIBETAN all nonhigh suffix vowels are raised to high after high base vowels. While nonhigh base vowels remain unchanged before unstressed high suffix vowels, they are raised before stressed high suffix vowels.

3) The domain of vowel harmony is almost always the morphological word, or, in some cases where the two do not coincide, the phonological word or breath group.

4) Vowel harmony is systematic rather than sporadic, affecting all or most grammatical forms subject to the general rule governing the occurrence of harmonic vowels.

5) Since the essence of vowel harmony is the alternation of vowels or classes of vowels determined by like vowels or classes of vowels, there must always be at least two classes, or grades, of vowels in any vowel harmony system that are mutually exclusive of one another within

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[2] However, there may on occasion be secondary assimilatory effects produced by adjacent consonants as in YORUBA where loan words ending in consonants (noncanonic in YORUBA) add an epenthetic vowel: u after a back vowel in the preceding syllable and i elsewhere. There are apparent exceptions to this harmony rule, when the final consonant is a labial, in which case the expected i after a front vowel is sometimes u (Awobuluyi, 1967: 5-7):

	sílɛ́ɛ̀ti	'slate'	kɔ́ɔ̀tù	'court'
but	jɛ́ɛ̀mù	'gem'	jíípù	'jeep'

[3] This agrees with Schachter's (1969: 344) generalization: "Feature values of non-vowels assimilate to those of adjacent vowels, rather than conversely."

the domain of harmony except as noted later in the body of this paper. A pair of alternating grades constitutes a dimension normally corresponding to a contrastive feature in the vowel system of the language.

Thus, in NZEMA, an EASTERN AKAN language, for example, all vowels in a given word must be either close or open, the two grades together forming a dimension of relative height:[4]

Height						
	Close	i	e	ä	o	u
	Open	I	ɛ	a	ɔ	U

The corresponding nasal vowels are aligned in the same manner. While one harmonic dimension is perhaps the most frequently encountered situation, there are quite a few languages with two interrelated dimensions and at least one, KARAITE, a TURKIC language spoken in Lithuania, with three. In a multidimensional system, only one of the dimensions is principal, the other or others being subordinate to it. An example of a two-dimensional system involving relative height and relative rounding is found in TUNICA, an AMERICAN INDIAN language once spoken in Louisiana, where word-final a preceded by a high vowel with an intervening ʔ assimilates to the determining vowel in both height and rounding:

		Rounding	
		Unrounded	Rounded
Height	Higher	ɛ	ɔ
	Low	a	

Here relative height is clearly the principal dimension, i.e. representing the basic contrast, while rounding is subordinate to it. The remaining vowels: i, e, o, u, function as determining environments but do not figure as alternants. In KARAITE, most suffixes have alternants with vowels reflecting primarily a front-back opposition and secondarily one in relative rounding. In addition, a few suffixes have alternants that represent a dimension of relative height, thus resulting in the following maximal system:

[4] The same format will be used throughout this paper to represent the basic harmonic systems of various languages: reading from the left, the horizontal axis designates the principal dimension; other axes, subordinate dimensions.

	Height: Low	Height: High	
Front-Backness: Front	e	i	Unrounded
		ü	Rounded
Front-Backness: Back	a	ı	Unrounded
		u	Rounded

Rounding

The three dimensions hitherto referred to with the articulatory terms (relative): height, front-backness. and rounding, represent the three most commonly occurring types of vowel harmony, usually designated: horizontal, palatal, and labial, respectively. Where there is apparent ambiguity as to which dimension is the principal one, historical or comparative evidence may sometimes be adduced to resolve the question as in the case of KIRGHIZ, a TURKIC language with the following system:

Palatal	Labial: Unrounded		Labial: Rounded	
Front	i	e	ü	ö
Back	ı	a	u	o

In PROTO-TURKIC, there was only palatal harmony involving the unrounded vowels. Labial harmony developed later. The earliest TURKIC texts show occasional instances of labial harmony but it is only at a later period that labial attraction[5] is found in some of the languages. In all modern TURKIC languages, palatal harmony is still fundamental and more or less rigidly adhered to, whereas labial harmony and attraction vary considerably in occurrence and regularity among the different languages.

In addition to these features common to all vowel harmony systems, there are certain other factors which must be considered:

1) The relative degree of assimilation, that is, total or partial. There are some languages which have only total harmony such as YUROK where under certain conditions nonhigh vowels of the pronominal prefixes

[5] The terms labial harmony and labial attraction are traditionally used in ALTAIC linguistics to refer to the assimilation of high and low vowels respectively. In this paper, except where labial harmony is used in direct contrast with labial attraction, as in this case, I use the term labial harmony to refer to the entire system or subsystem of labial assimilation in a given language, paralleling the use of the terms palatal and horizontal harmony.

in nominal constructions and the inflectional suffixes in verbs completely assimilate to ɹ̲ (mid central with slight retroflection) of the following or preceding syllable. Further, verb stems with ɹ̲ in the final syllable may produce ɹ̲- harmony of all prefixes and suffixes appended to it. Then there are languages which have only partial harmony such as LHASA TIBETAN where nonhigh vowels assimilate in part to high vowels (both regressively and progressively). And finally, there are languages with both total and partial harmony such as FINNISH where most suffix vowels participate in partial palatal harmony determined by the stem vowels but the vowel of the illative singular assimilates totally to the final vowel of the stem. A rather interesting example of combined partial and total harmony can be found in MAZAHUA (OTOMÍ). In this language, the vowel of the stem formant (suffix) is determined by that of the root: ə̲ after back vowels, i̲ after ɛ̲, and a total harmonic vowel after the remaining vowels (nonlow, nonback). In CLASSICAL MONGOLIAN, the basic pattern is a very regular palatal harmony but the low rounded vowels (o̲, ɵ̲) occur only after stems with the same vowels. As we shall see below, the degree of assimilation may well be an indication of the stage of development of a given harmonic system.

2) The direction of assimilation between the two grades of a dimension or viewed from the standpoint of determination, dominance relation (compare Aoki's use of the term "symmetry" (1968) — i.e. either assimilation can only operate in one direction (dominant system) or it can operate equally in both directions (equipollent system) — is of course of crucial importance in ascertaining some of the general features of vocalic assimilation in natural language. If, for example, horizontal systems tend to be dominant more often than palatal systems, as the present sample would indicate, this may point to a basic lack of equivalence between the two dimensions. Then too, the dominance relation can be expected to have a direct bearing on the validity of the thesis that "unmarked feature values assimilate to adjacent marked feature values, rather than conversely." (see Schachter, 1969: 346).

3) The existence of so-called "neutral" vowels. I use the epithet "so-called" advisedly. In connection with vowel harmony, the term neutral has generally been used to refer to determined or assimilated vowels which may appear in conditioning environments for two or more grades, in other words, which function as members of different grades such as CLASSICAL MONGOLIAN i̲. This language has a seven-vowel system:

i ü u

e ɵ o

a

which, in accordance with the fairly rigid rule of palatal harmony, must be divided into two grades:

Front	e	ö	ü
Back	a	o	u

That is, any given word can contain either front or back vowels but not both. In addition to theinternal harmony of the root vowels, the quality of the suffix vowels is determined by the relative palatality of the former. The vowel i, however, is neutral in the sense that it may occur in suffixes following roots with either front or back vowels. As a determining (root) vowel, i is also neutral, i.e. determined vowels following it may be either front or back, but not entirely so. Thus, when i is present in all root syllables, determined vowels must be front. Similar examples of this kind of partial neutrality of the determiner are to be found in languages with horizontal harmony (the vowel a in MASAI) or labial harmony (the vowel ə in EASTERN CHEREMIS). Then there are languages in which a given vowel is neutral as the determined vowel but always harmonic as the determiner (e.g. ɯ in KOREAN horizontal harmony, e and a in KARAITE labial harmony). Of the nine theoretically possible combinations of harmonic and neutral vowels, examples of the following were actually found in the present sample (Ø = all vowels harmonic, N = one [or more] vowel always neutral, (N) = one [or more] vowel sometimes neutral under language-specific conditions):

Determiner	Determined		
	Ø	N	(N)
Ø	1	2	3
N	4	5	-
(N)	-	6	7

Some languages in which these types were found:

Horizontal: IBO (1), TIBETAN (2), AKAN (3), TELUGU (4), NEZ PERCE (5), MASAI (7)

Palatal: EASTERN OSTYAK (1), ALTAI (2), SPOKEN MONGOLIAN (5)

Labial: KARAITE (2), TUNICA (5)

Thus, when we speak of neutral vowels, we must also take into consideration the directional status (determiner, determined) and cooccurrence restriction (i.e. conditioned or unconditioned neutrality) of the vowels in question. As regards the latter, there is sometimes another kind of restriction that is imposed on one or more vowels. In CLASSICAL MONGOLIAN, for example, when the vowel of the first syllable of the determiner root is ö, it can only be followed by ö in all the

remaining syllables of the word; similarly for o except that it may on rare occasions follow an initial i. This phenomenon has been referred to as a "partisan vowel," that is, a single vowel determined by a single vowel, an extreme case of labial harmony which is superficially tantamount to total harmony.

4) Still another consideration is what Aoki (1968: 144) calls "alternating" versus "nonalternating" systems or what could be viewed as external versus internal harmony. While all external harmony languages have, as a matter of course, internal harmony, the presence of the latter does not necessarily imply that of the former. It is precisely such cases of internal harmony without accompanying external harmony which are of particular interest in terms of historical studies. Unfortunately, such evidence as I have assembled for this kind of internal harmony is much too sketchy to permit any generalizations at this time.

2. Development of vowel harmony

In this section, we will examine some of the conditions that favor the development of vowel harmony. Since assimilation is total or partial neutralization of contrastive features in specified environments, it represents loss or "weakening" of those features. I therefore propose that in the case of vowel harmony, ceteris paribus, when any one or any combination of the following conditions are present, vowels will be more prone to harmonize.

2.1 Vocalicity. Harmonizing vowels tend to be relatively less vocalic than others in terms of properties generally associated with or which constitute defining characteristics of vowels as opposed to consonants. That is, they may be expected to be less sonorous: higher, shorter, less fully voiced, unstressed. This can be restated as a general hypothesis:

> The less sonorous a vowel (or class of vowels) the more prone it will be to assimilate; and conversely, the more sonorous it is the more resistant it will be to assimilation.

There is a good deal of evidence in support of the view that high vowels tend to assimilate more readily and earlier than low vowels. Thus in AKAN, where oral vowels assimilate to following nasals, only the high vowels participate. In the ALTAIC languages, labial harmony (involving the high vowels) developed before labial attraction (low vowels). According to Korn (1969: 104) in TURKIC in general high unrounded suffix vowels assimilate to low rounded stem vowels more often than do low unrounded suffix vowels. In MODERN STANDARD MONGOLIAN, word stress is on the first long vowel or diphthong or, in the absence of same, on the vowel of the second syllable unless that vowel is i in which case it falls on the vowel of the first syllable. In other words, the high vowel i is the only vowel incapable of being stressed. While i is neutral as a determined vowel, historically it occurred only after front stem vowels

(before the merger of *i and *ï). In SOUTH DRAVIDIAN, short high vowels were lowered before a of the following syllable earlier than the mid and long vowels. In MAZAHUA (OTOMÍ), the quality of the stem-formant suffix vowel is determined by the root vowel. For the oral vowels, the suffix vowel totally harmonizes with a high nonback root vowel and partially harmonizes with other root vowels. A possible counterexample to this proneness of high vowels to assimilate before low vowels is the case of PROTO-URALIC. The evidence points to root-internal harmony originally involving an opposition between *ä (front) and *a (back), a somewhat less well attested one between *e and *ə, and in derived stems an additional one between *ü and *u. As it concerns the hypothesis advanced here, the question in this case is whether internal harmony represents the earliest stage of vowel harmony or not, a question I cannot answer at this time.

Additional evidence of the correlation between high vowels and assimilability can be adduced from the forms anaptyctic vowels assume in many languages. In a brief but informative article on anaptyctic and deletable vowels, Hooper (1972) offers examples of interconsonantal anaptyctic vowels that are either "minimal" (the vowel other vowels reduce to in weak position) as ENGLISH ə, high (BRAZILIAN PORTUGUESE, JAPANESE, NUPE), or totally harmonic with neighboring vowels (GA [NIGER-CONGO], EARLY LATIN). These types strikingly parallel similar kinds of vowel harmony. In fact, if assimilation as an evolutionary process is viewed as a natural progression from partial to total assimilation followed by reduction and finally deletion, then anaptyxis would appear to be in some ways its mirror image. A perfect example of this parallelism is found in the MAZAHUA stem formants alluded to above. As noted, a high nonback root vowel determines a totally harmonic vowel (including a) results in suffix-vowel ə, corresponding respectively to Hooper's totally harmonic, high, and minimal types. In KOREAN, when juxtaposition of consonant-final stem and consonant-initial suffix would result in an unpermitted cluster, the vowel ɯ is inserted between the two consonants. It is of interest to note that ɯ and i are neutral determined vowels in the KOREAN system of horizontal harmony. Originally, neither of these vowels was neutral, *ɯ harmonizing with back and *i with front vowels in the earlier system of palatal harmony. In WASHO (a HOKAN language), anaptyctic vowels are inserted between consonants before a stressed vowel. If the first consonant is a glottal stop or spirant, the vowel is totally harmonic with the preceding vowel; otherwise, it is ɨ. As we shall see later, intervening glottal consonants present less of a barrier to harmonizing vowels than any other consonants, hence the expected total harmony. In YORUBA, when loan words with inadmissible consonant clusters or which end in noncanonic consonants enter the language, the anaptyctic vowel is i in the neighborhood of front vowels (or occasionally of palatal consonants), u near back vowels (or labial consonants), and either of the two high vowels near a.

Barring evidence to the contrary, this leads me to propose the following:

> Ceteris paribus, assimilation of low vowels implies prior assimilation of high vowels.

It should also be noted that, in terms of duration, high vowels are intrinsically shorter than low vowels (see Malmberg, 1963: 75 and Jakobson, Fant, Halle, 1969: 58). While the data examined in the course of this study nowhere indicated that phonetically or phonologically long vowels tend to assimilate to other vocalic environments, it did provide some evidence for the converse. Thus, for example, in the above-mentioned case of SOUTH DRAVIDIAN, the short high vowels assimilated earlier than the remaining short vowels and before all the long vowels. Similarly, in HUNGARIAN the short mid vowels were affected by labial attraction (presumably borrowed from or at least stimulated by contact with TURKIC languages) whereas none of the long vowels were. While these examples are far from conclusive, they are suggestive of a direct correlation between relatively short duration and susceptibility to assimilation. One further comment on duration. In discussing vowel harmony in YUROK, Robins (1958: 26) states that the pronominal prefixes occurring with nouns are subject to optional harmony but "the forms with vowel harmony are more common in connected speech; those with _e_ [non harmonic] are more usual in the isolated utterance of the words concerned, but fixed phrases involving such words always appear with vowel harmony." Of course, it may be assumed that the discourse forms are generally shorter than those occurring in citation.[6]

Although I have found little direct evidence of a connection between less fully voiced vowels and greater assimilability, there is considerable indirect evidence pointing to that possibility. A direct correlation does

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[6] A few other sociolinguistic influences on vowel harmony are of at least passing interest. Thus, for STANDARD COLLOQUIAL BENGALI, Chatterji (1926: 401-2) notes that the horizontal harmony affecting the vowel of the second syllable is especially noticeable in the speech of women and among the uneducated. Similarly, in MODERN SPOKEN TIBETAN female speakers often assimilate vowels in words where male speakers do not (Miller, 1966: 256-7). In NEZ PERCE, exceptions to vowel harmony are often found in the speech of younger informants (Aoki, 1966: 760). In the Iranized dialects of UZBEK spoken in urban areas, TURKIC vowel harmony has all but disappeared as opposed to the UZBEK spoken in rural areas where it is retained (Menges, 1968: 79 and Baskakov, 1960: 48). And finally, in connection with the last-mentioned kind of interference, for many of the languages included in the present sample loan words -- particularly recently acquired -- are reported as constituting exceptions to vowel harmony.

exist in KRONGO, an EASTERN SUDANIC language, which shows partial or total harmony of word-final unstressed suffix vowels that are often partially devoiced. Indirectly, there is first the fact that high vowels are less resistant to devoicing than low vowels (see e.g. Greenberg, 1969: 162-3). Second, voiceless vowels bear the weakest degree (or really none) of stress (ibid. 160) and, as we shall see below, weak stress is often concomitant with harmonizing vowels. Third, voiceless vowels are generally low-pitched, the assumption being that low-pitched vowels are more likely to become voiceless than high-pitched ones (ibid. 161-2). Now it is also true that there are general correlations between low pitch, lax vowels, short duration, reduced audibility and amplitude, and voiced obstruents (on this last connection, see especially Hyman and Schuh, 1972 for a clear, interesting exposition of this phenomenon in several AFRICAN languages but also Zahn, 1940, for its relevance in JABEM, a language of New Guinea, and Doke, 1926, for ZULU) on the one hand and between high pitch, tense vowels, long duration, greater audibility and amplitude, and voiceless obstruents and implosives on the other. Furthermore, in terms of markedness, voicing in obstruents and voicelessness or devoicing in vowels must both be viewed as marked features and, if vocalic duration is construed as reduced (a term sometimes used to characterize the duration of lax vowels) versus normal or full, then it would appear that the latter is unmarked and the former marked. As we have seen, high vowels are characterized by some of these same features, namely short duration, reduced audibility and amplitude, and a greater tendency to devoice, and perhaps to that extent they are more marked, i.e. less vocalic (consider also the extremely widespread occurrence of nonsyllabic allophones of high vowels), than other vowels. But high vowels are also more prone to assimilate to other vowels. This being the case, we would expect voiceless or partially voiced vowels to share the same property.

There is considerable evidence indicating that unstressed vowels are more likely to harmonize than stressed vowels and conversely that stressed vowels often determine the quality of unstressed harmonic vowels. In LHASA TIBETAN, for instance, nonhigh unstressed suffix vowels are raised to harmonize with high base vowels which may be stressed or unstressed, a case of progressive assimilation. But when a high suffix vowel is stressed and a nonhigh base vowel is unstressed, the process is reversed, the suffix vowel determining the quality of the base vowel, a case of regressive assimilation yet clearly another manifestation of the same process of vowel harmony. In DYEGEM SERER, certain unstressed monosyllabic verbal (pronominal) and nominal (prepositional, coordinating) proclitic vowels are subject to vowel harmony determined by the vowel of the first syllable of the root (i.e. of the word) which is normally stressed. However, in addition to this word stress, the initial syllable of a phrase receives strong stress. Thus, when the proclitic is in close juncture with the preceding word, its vowel is subject to

harmony, but when it is in open juncture, harmony is blocked. In other words, when an otherwise harmonizing unstressed vowel becomes stressed due to intonational factors, it can no longer harmonize. In the vestigal horizontal harmony found in GILYAK, only unstressed a alternates with ɣ. In most URALIC and ALTAIC languages with vowel harmony, stress falls on the initial syllable of the word (or root) which determines the quality of the unstressed suffix vowels. This is also generally true of the TURKIC languages with a few notable exceptions. In PROTO-ALTAIC, the initial syllable was stressed but there was a rising tone on the ultima. In TURKIC, the latter tended to dominate the former to the extent that, in some languages like KAZAN and VOLGA TATAR and TURKMEN, a single accent on the ultima evolved. However, all these languages have retained the original ALTAIC palatal harmony (labial harmony is a later, chiefly TURKIC development) so that in some cases determined vowels may be stressed. On the other hand, the only explicit counterexample I have found is a case of vowel raising or lowering in OLD KANNADA which apparently only occurred in word-initial stressed syllables (Sreekantaiya, 1937).

2.2 Contiguity. I use this as a broad term to cover various phonological and syntactic environments which provide favorable conditions for harmonizing vowels.

Phonologically, one would expect that contiguous vowels would be most likely to assimilate to one another and, the more removed from contiguity, the less likely they would be to do so. Thus, in GWEABO, oral vowels are nasalized only after contiguous nasalized vowels in the same word. And in KARAITE and HUNGARIAN, the most effective way of defining the determining vowel is to identify it as the root-final vowel (which conditions successive suffix vowels) rather than some other root vowel. As noted above, in SERER proclitic vowel harmony is dependent to a certain extent on the type of juncture which separates the proclitic from the preceding word: harmonic vowel with close juncture and non-harmonic with open. In SINGHALESE, back vowels were fronted before front vowels if they occurred in heavy syllables (CV̄, CVC) but became totally harmonic in light syllables (CV).

Among the possible consonant types that may intervene between two harmonic vowels, by far the least resistant to the pervasion of vocalic assimilatory features is the class of laryngeal consonants. Among the URALIC languages, for example, where partial palatal harmony is the rule, we find total harmony of the vowels of the illative singular case suffix (-h V n) in FINNISH and the separative singular (-h V d) in YUROK. In MAZAHUA, harmonic vowels (oral) occurring in stem formant suffixes fall into two classes:

1) totally harmonic in those beginning with h or ʔ;

2) in those beginning with other consonants: totally harmonic, i or ə, depending on the quality of the root vowel.

In IBO, oral vowels of noun prefixes are nasalized before nasal vowels across an intervening root-initial h. In YUROK, pronominal prefixes occurring with nouns have the general shape Ce- the vowel of which may optionally harmonize totally with an ə (mid central) of the first syllable of the following root or with either of the remaining non-high vowels (a, o) if the intervening consonant is ʔ. TUNICA has progressive partial horizontallabial harmony of the vowels of suffixes, postfixes and auxiliary verbs beginning in ʔ. Note also the determination of anaptyctic vowel quality in WASHO mentioned above (2.1). These are but a few examples from a long list of languages with similar situations.

While perhaps not quite as common as with laryngeal consonants yet fairly widespread is the related phenomenon of harmonic vowels occurring across an intervening velar, postvelar or uvular consonant. Thus, in KONKOW, a CALIFORNIA PENUTIAN language, the only kind of progressive harmony involves total harmony of suffix-initial i after stem-final velar stops (this is, incidentally, another example of the greater proneness of high vowels to assimilate earlier than others). In EFIK, the vowel of the negative suffix, -ke ~ -xe ~ -ɣe, may assimilate totally to the preceding vowel. In QUILEUTE, suffix vowels harmonize totally with preceding vowels when a glottal stop or postvelar obstruent intervenes. And in YUROK, in addition to the above-cited suffix-vowel harmony across h, there are many stems which show internal harmony with identical vowels flanking both h and the velar spirants. The same applies to suffix vowels following stem-final velar spirants.

Another possible indication of the relative weakness of velars in terms of assimilation in general is the rather high incidence of velar consonant harmony, often induced by the relative gravity of adjacent vowels. This is characteristic of ALTAIC in general and TURKIC in particular. The typical situation in TURKIC consists of an alternation between k and g before or after front vowels and q and ɣ respectively before or after back vowels. In KARAITE, for example, rigid palatal harmony combined with the resultant velar harmony produces words that are entirely, or almost so, composed of either palatal vowels and consonants or velars. The same type of consonant harmony, also caused by earlier established palatal harmony, is found in VOGUL and in EASTERN OSTYAK where it would appear to be incipient, that is, all velar consonants have palatovelar and velar or post-velar allophones in the neighborhood of front and back vowels respectively. In SAHAPTIN, the sole evidence for the existence of the earlier system of SAHAPTIAN vowel harmony still in part manifest in the related NEZ PERCE language is the presence of palatalized allophones of the velar stops in the environment of the front vowels e and æ and the fact that the vowel o anywhere in the word blocks such

palatalization. In YAKUT, a TURKIC language with palatal and labial harmony, there is a different kind of consonant harmony: k ~ x in the general environments of high and low vowels respectively. That is, consonantal closure assimilates to vocalic closure.

While the next two examples of consonant harmony are not directly related to processes of vowel harmony, they offer additional evidence in support of a natural gravity hierarchy of consonantal assimilability on the one hand and of resistance to the pervasion of vocalic features on the other. In JABEM, as noted above (2.1), there is a direct correlation between tone and voice as it pertains to certain consonants: voiceless stops are found in the environment of vowels with high tone and the corresponding voiced stops are found with low tone. The stops affected are the dentals and velars. Similarly, in some TURKIC languages there is progressive assimilation in voicing of stops dependent on the preceding consonant. In KARAITE, this involves the dental stops and all four velar obstruents. Granted the fact that the evidence is limited, there does appear to be a definite pattern, at least insofar as obstruents are concerned. Furthermore, this susceptibility of velar consonants to admit pervasive vowel harmony and to participate in consonant harmony more readily than more fronted consonants is hardly an isolated phenomenon. In my paper on consonant gradation (1970: C20), I pointed out that the same hierarchy exists within a gradation system that reflects lenition where posterior consonants are more unstable, i.e. more likely to assimilate, than anterior consonants. Similarly, in discussing glottalic consonants Greenberg (1970b: 127-30) notes that among implosives, which are generally lax as opposed to ejectives,[7] velars are extremely rare and palatals tend to be more unstable than bilabials and dentals.

We may therefore conclude that, where intervening consonants exert an influence on the operation of vowel harmony, there is a universal tendency for harmony to occur most readily where no consonant intervenes (i.e. between contiguous vowels) and next, in descending order of probability, from posterior to anterior consonant.

Although I have not collected any data on a comparable hierarchy of manner of articulation, logically one might suppose that voiceless stops would offer the greatest resistance to the operation of vowel harmony and glides the least. In other words, the more open the articulation, the more vowel-like the consonant. In their treatment of the

[7] But compare Hyman and Schuh (1972: 41-2) who maintain that implosives are tense and associated with high tone and also Doke (1926: 205) who finds that the implosive stops in ZULU tend to be associated with high or mid tones while plain voiced stops are associated with low tone. Greenberg, however, does agree with the preceding authors in noting that implosives are not associated with tone lowering.

process of tone spreading, which is analogous to progressive vowel harmony, Hyman and Schuh (1972: 43-4) show that this type of assimilation (high-low-high → high-falling-high) may be further simplified (high-falling-high → high-high-downstep high) dependent upon the nature of the consonant intervening between syllables two and three. The hierarchy of likelihood for the rightward pervasion of the high tone is, from most to least likely, across: voiceless obstruents, voiced obstruents, sonorants. This implies that low tone is compatible with sonorants, the most vowel-like consonants. Furthermore low pitch is a characteristic of lax segments (both vocalic and consonantal) as opposed to the higher pitch of corresponding tense segments. While the evidence from the present sample is somewhat contradictory on this point, there does appear to be a greater tendency for lax vowels to assimilate to tense rather than the converse. Other factors must undoubtedly come into play which might account for the counterexamples. If, however, this should ultimately prove to be a valid assumption, it would go a long way toward explaining the parallels between tone spreading and vowel harmony.

Morphological or intraword contiguity is also often an important factor determining the domain of vowel harmony. As earlier noted, the latter almost always corresponds to a morphologically and/or syntactically definable word. Most of the apparent exceptions to the general rule can be explained in terms of relative grammatical contiguity. In the case of non-harmonizing affix vowels, the general principle appears to involve differences between inner and outer layer affixes. Thus, the typical BANTU close-open mid-vowel harmony affects certain derivational suffixes in the verb but not inflectional affixes and in prehistoric and OLD KANNADA close-open umlaut occurred only in derived forms. In YUROK, while harmony of prefix and suffix vowels is optional, that of infixes is obligatory. In FINNISH and HUNGARIAN, primarily suffixing languages in which all prefixes are derivational, prefixes do not obey the rules of vowel harmony that govern most suffixes. Similarly, in TUNICA only suffixes, postfixes, and auxiliary verbs (postposed) are subject to harmony. The inflectional noun prefixes of the BANTU languages do not harmonize with noun stems. While the vowels of MAZAHUA verb stem-formant and object suffixes harmonize with the preceding root vowel, enclitic vowels do not. In SPOKEN MONGOLIAN where most suffixes participate in palatal harmony, the emphatic form of the imperfect past is an exception while the neutral form of the same category follows the rule. HUNGARIAN labial harmony affects only the first suffix following the stem and in KARAITE, where only the high vowels participate in labial harmony, the latter is neutralized in suffixes separated from a preceding harmonic suffix by a suffix with a low unrounded vowel. In EASTERN CHEREMIS, unlike other suffixes, the plural suffix is nonharmonic. As Sebeok notes (1961: 11): "In this and

other ways, -blak resembles a stem rather than a suffix." We find similar situations in EFIK where the first and second person plural prefixes do not harmonize and in MODERN TELUGU where the nominal plural suffix is nonharmonic. While the EFIK and TELEGU sources (Ward, 1933: 54 and Bright, 1966: 319 respectively) offer no clues as to why plural markers should constitute exceptions, Stuart (1957: 87) may provide a general explanation to such cases when he notes that in MODERN STANDARD MONGOLIAN the major exceptions to vowel harmony are loan-words and a few suffixes with high frequencies of occurrence. Certainly in most languages we can expect plural markers to fit the latter category. This of course equates high frequency of occurrence with stability, resistance to change.

Another indication of the effect of morphological contiguity is found in cases where the determining stem is a compound. As we shall demonstrate below, the different elements of compound stems generally do not harmonize with one another. In all such instances, the languages sampled invariably show harmony between the affix and the nearest compound element, i.e. between prefix and initial element and between suffix and final element. The closely related identification of the final vowel of a polysyllabic stem as the determining vowel for the harmonic vowel of the suffix, as in HUNGARIAN and KARAITE has already been noted above. With very few exceptions, descriptions of vowel harmony are explicit about the fact that the different elements of compounds maintain their original internal harmony when combined, thus resulting in words that, superficially at least, constitute violations of the rules of harmony. This is so in: IBO, JABEM, TUNICA, YORUBA, FINNISH, CLASSICAL MONGOLIAN, and EASTERN OSTYAK, to name but a few.

Another recurrent type of exception to affixal harmony consists of nonharmonic affixes that enter the language at a time when the process of vowel harmony is no longer productive but has not yet disintegrated as in KARAITE, for example (in the TRAKAI dialect, the adjectival -muš with either front or back vowel stems: k+z+lmuš 'reddish', yešilmuš 'greenish').

In HUNGARIAN, we find a different kind of exception, -kor, a suffix with an extremely restricted distribution to begin with and which furthermore originally occurred chiefly with a single noun óra 'hour' in constructions of the type öt órakor 'at five o'clock'. The semantically redundant óra being frequently subject to ellipsis, -kor came to be suffixed directly to the cardinal regardless of the latter's vowel harmony, thus producing not only harmonic forms like háromkor 'at three o'clock' but also nonharmonic forms like ötkor 'at five o'clock'. Similar to this phenomenon is the case where an earlier free form becomes a bound form which retains its original vowels as happened in SPOKEN MONGOLIAN with the negative suffix -gwi < ugwi, a negative noun that occurred as the second element in certain compounds.

A final word on contiguity. In most cases, loanwords constitute exceptions to the rules of vowel harmony. Stretching the point perhaps, this could be construed as a sociolinguistic manifestation of the principle of interference with vowel harmony due to relative noncontiguity between the two different speech communities.

2.3 Phonetic distance. A factor which sometimes appears to contravene the dictum that high vowels are more prone to assimilate than low is the relative phonetic distance between different sets of vowels, that is, the relative proximity in terms of articulatory features of two potential corresponding members of the different grades of a harmonic dimension. The relationship can be formulated as follows:

> The lesser the phonetic distance between opposing members of potential vowel grades the more prone they will be to harmonize.

In both PROTO-URALIC and PROTO-FINNO-UGRIC, the system of palatal harmony which in MODERN FINNISH and HUNGARIAN, for example, affects both high and low vowels (with the exception of the neutral vowels i and e) began with stem-internal harmony involving alternation of the low vowels *ä ~ *a only and perhaps *e ~ *ə. It was only at a later date that these alternations were extended to suffixes along with *ü ~ *u, while *ö ~ *o did not appear until even later still. Somewhat analogously, in IBO horizontal harmony the low vowels assimilate totally while the high vowels do so only partially.

3. Markedness and dimensional hierarchies

3.1 Markedness. Earlier in this paper I pursued a line of reasoning linking certain features associated with vowels and consonants in terms of the theory of markedness in an effort to show that high vowels have a greater tendency to assimilate to other vowels. Continuing along these same lines, I propose to examine basic relationships within and between dimensions of vowel harmony. One of the keys to the somewhat intricate network of interrelations is the establishment of a natural markedness criterion for tonal features.

Now there is a well-attested direct correlation between high tone and voiceless obstruents and between low tone and voiced obstruents (Hyman and Schuh, 1972; Zahn, 1940; Doke, 1926; and see 2.1 above). And, since voicing is a marked feature for obstruents, we may at least tentatively infer through extrapolation that high tone is unmarked and low tone marked.

One of the characteristics of tense segments is higher pitch. Others, for tense obstruents, are voicelessness and (phonetic) length, and, for tense segments in general, greater muscular tension, subglottal pressure, audibility and amplitude which, inasmuch as they pertain to vowels, imply (intrinsically) stressed as opposed to stressless lax vowels. Since

voicelessness in obstruents and phonetic length in vowels are unmarked, the feature tense could be regarded as unmarked and lax marked.

Front vowels have higher second formant frequencies than back vowels (a fact which may be further verified by Ladefoged's whisper test: 1962: 103) and are often phonetically longer than back vowels (Malmberg, 1963: 75). In addition, the feature tense involves fronting and raising (see especially Stewart, 1967: 196-200). Thus, in ASANTE, for example, (tense) /u/ — [ʉ] before (tense /o/ of the following syllable but (lax) /U/ is not fronted before (lax) /ɔ/, while in ZULU the tense mid vowels e̲ and o̲ occur before the high vowels but also before the syllabic nasals m̩ and n̩ and the lax ɛ̲ and ɔ̲ are found before nonhigh vowels and ŋ̩, i.e. lax vowels before velar (or retracted) nasal and tense vowels before nonvelar (or advanced) nasals. Analogously in SPOKEN MONGOLIAN, g̲ is fronted word initially or finally before or after respectively a front vowel but medially only before a front vowel with an intervening voiceless (tense) consonant. We may therefore assume that front vowels (and probably consonants also) are unmarked and back vowels marked. This is also in accordance with another natural hierarchy, viz. rounded vowels are marked and unrounded unmarked, since rounding is a marked feature for front vowels and an unmarked one for back vowels.

As shown above (2.1), high vowels are marked and low vowels unmarked with respect to the vocalicity features of voice and relative duration. Furthermore, to my knowledge, all vowel-frequency studies that have been made indicate that the frequency of occurrence of the low central (unrounded) vowel by far outstrips that of the other vowels in the system, thus lending support to the hypothesis that low vowels are unmarked.

Still another possible indication that this is true is the fact that F_1 formant frequencies, which are an index of vowel height, are high for low vowels and low for high vowels. Now if tense is unmarked (see also Chomsky and Halle, The sound pattern of English, 1968: 405), there is an additional correlation between tense segments and low vowels, since one of the identifying characteristics of the former is higher pitch.

These considerations should then lead to a number of qualified predictions regarding intradimensional hierarchies in cases of vowel harmony, ceteris paribus, assimilation of:

(1) vowels with high tone implies that of vowels with low tone;
(2) fully voiced vowels implies that of partially voiced or voiceless vowels;
(3) stressed vowels implies that of unstressed vowels;
(4) vowels with normal duration implies that of reduced vowels;
(5) tense vowels implies that of lax vowels;
(6) low vowels implies that of high vowels;

(7) front vowels implies that of back vowels;
(8) unrounded vowels implies that of rounded vowels.

In short, marked feature values are more prone to assimilate than unmarked.

3.2 Dimensional hierarchies. In examining instances of multidimensional (usually bidimensional, rarely tridimensional) vowel harmony, we find that the dimensional hierarchy exactly parallels one of the intradimensional hierarchies. With the possible exceptions noted below, in all cases of bidimensional harmony the labial dimension is subordinate to either the horizontal or palatal dimension. This is true both synchronically and diachronically. Examples are numerous, chiefly from ALTAIC, especially TURKIC, but also from URALIC, BENGALI, IBO, and MANDI. In TUNICA, the principal dimension of horizontal harmony involves the raising of the low central vowel to an open mid vowel which may be either ɛ̲ or ɔ̲ dependent upon the quality of the determiner vowel. Since all front vowels are unrounded and all back vowels rounded, the contrastive feature that separates the two series is ambiguous, i.e. it could be regarded as relative front-backness or roundedness (see chart in sec. 1). In EASTERN CHEREMIS, a superficially similar situation exists. Except for the neutral vowel ə̲, only the mid vowels participate in the system of vowel harmony. In this case, however, the labial dimension must be viewed as the principal one and the palatal dimension as secondary:

	Front	Back
Round	ö	o
Unrounded	e	

but not *

Front	e	Unrounded
	ö	Rounded
Back	o	

Historically, of course, the situation was just the reverse: palatal harmony was primary and labial harmony secondary. In KARAITE, the original system of palatal harmony with a later overlay of labial harmony has developed a third dimension, horizontal, which affects a few suffixes. While horizontal harmony involves the same number of alternants as the principal palatal dimension, its grammatical range is much more restricted than either palatal or labial harmony. In that sense, it would appear to be secondary to both of the other dimensions. But formally, the latter are subordinate to it:

	Front		Back	
	U	R	U	R
High	i	ü	ɨ	u
Low	e		a	

This example provides a striking parallel to the natural markedness hierarchy of the three primary vocalic dimensions. The rounded-unrounded dimension is secondary to the front-back and the latter is secondary to the high-low. As Trubetzkoy (1969:106) pointed out: there are languages with only linear vowel systems but not the converse. Thus, translated into the terms of vowel harmony, labial harmony is marked with respect to palatal harmony and the latter is marked with respect to horizontal harmony. Another indication of the primacy of horizontal harmony is found in the relative frequency of occurrence of the three types in the present sample. Despite the fact that almost all examples of palatal harmony came from only two families, URALIC and ALTAIC, as opposed to a considerably more random distribution of languages with horizontal harmony, the latter was much more common than the former, while labial harmony was the least common of all.

4. Skewed harmony

Hitherto we have discussed only harmonic systems involving one or more of the three primary vocalic dimensions: horizontality, palatality or labiality. Aside from instances of superimposed dimensions like oral-nasal harmony (as in AKAN, GWEABO, IBO and NZEMA), I have found a few cases of skewed harmony. While their number in the present sample is really too few to permit much generalization, they do appear to be reducible to two general types. The first comprises systems that have or appear to have resulted from historical changes engendering a partial shift from an earlier system based on one of the primary dimensions to one based on another dimension. The second includes systems originally based on one of the primary dimensions but which, through historical change, have lost certain qualitative contrasts in one of the grades, the vowels in question being typically reduced or centralized.

A good example of the first type is KOREAN. Ramstedt (1939: 25-8) reconstructs a typical ALTAIC vowel system with the palatal harmony characteristic of those languages. Through a lengthy and somewhat complex series of changes, many of the earlier front vowels became high while the back vowels became low, resulting a slightly skewed horizontal system:

PROTO-KOREAN

*Front	i	ä	ü	ö
*Back	ɯ	a	u	o

EARLY WRITTEN KOREAN

High	ə	ɯ	u
Low	a	ʌ	o

MODERN KOREAN

High	e	ə	u
Low	ä	a	o

Both *i and *_ became neutral vowels due to various mergers. SOMALI may be another instance of this sort of process but in what would appear

to be an early stage of transition from one system to another. Many of the adjacent EASTERN and CENTRAL SUDANIC languages (e.g. MORU, MADI, AVUKAYA, MASAI, MANGBETU, ACHOLI, BARI, TESO, NANDI, LANGO) and KOMAN have the open-close (or lax-tense, retracted-advanced tongue root, creaky-hollow, etc.) variety of horizontal harmony. The SOMALI system is nearly identical to these:

Tongue Root: Advanced	i	e	æ	ɸ	y
Retracted (or Neutral)	I	ɛ	a	ɔ	U

with the exception that in the advanced grade the rounded vowels corresponding to the retracted back rounded vowels are phonetically front vowels and what is normally some kind of a mid central vowel in the advanced grade in the SUDANIC languages is here a low front vowel of approximately the same height as the former. Tucker and Bryan (1966: 497-8) describe what I refer to as the advanced grade as "fronted" versus the "normal" or retracted grade.

A historically attested example of the second or reduced type is found in EASTERN CHEREMIS where the original PROTO-URALIC system of palatal harmony:

*Front	e	ä	ü
*Back	õ	a	u

was replaced by a labial system (see 3 above) with a secondary palatal distinction due primarily to the development of ö < PU *õõ and the reduction of PU *a, *e, and *ü to ə in certain environments. Another case that seems to fit this type is the centralization of mid vowels (e, o) in YUROK (see 1 above). The MAZAHUA example referred to above also appears to be the result of a process of reduction, possibly from an earlier system of palatal harmony.

5. Neutral vowel

No discussion of vowel harmony would be complete without some examination of neutral vowels and how they affect the various kinds of harmonic systems. With few exceptions, a low central vowel (a) is found as the neutral determiner or determined vowel, or both, in horizontal systems, while in palatal systems the vowel is typically a high front unrounded vowel (i). As for the exceptions to these general rules, at least for those languages on which information was readily available, they can be explained in terms of historical development.

Thus, in YORUBA, a language with horizontal harmony of the close-open variety, the neutral determiner vowels are i and u, while the neutral determined vowels are the expected a but also i. In this case, the high vowels are the products of mergers of the earlier close and open vowels:

$$\begin{matrix}*i \\ *I\end{matrix} > i \quad \text{and} \quad \begin{matrix}*u \\ *U\end{matrix} > u$$

thus eliminating the contrast between close and open for the high vowels. In the case of KOREAN, the neutral determined vowels are i and ɯ,[8] what we would expect for a palatal system, but in fact as noted above (sec. 4) the KOREAN system evolved from an earlier palatal harmony and in the process produced the modern vowels i and ɯ through a number of mergers involving both front and back vowels. In NEZ PERCE and closely related PALOUSE, the slightly skewed horizontal system has neutral i for both, determiner and determined vowels (the NEZ PERCE vowels /e, a, o, u/ are shown with their phonetic norms to better represent the vowel harmony relationships):

High	æ	ɯ ~ u
Low	a	o

Jacobsen (1968: 821-2) has posited an earlier sixth vowel, *ə, which merged with *i to become i in order to explain neutral i. As we shall see below, this exactly parallels the typical development of neutral vowels in palatal systems. Furthermore, as the phonetic values of the modern vowels indicate, there exists a slight palatal bias between the high and low vowels of the harmonic system (i.e. æ:a and ɯ [~u]: o). While this may be mere conjecture, there does appear to be some evidence in favor of positing an earlier system of palatal harmony for NEZ PERCE.

As for the apparent exceptions to neutral i in cases of palatal harmony, these too can in part be explained in terms of two different types of mergers. In PROTO-URALIC, the neutral vowels, both determiner and determined, were *i but also *ï. The latter was of rare occurrence and merged with *i in FINNO-UGRIC. Thus, it seems likely that URALIC *ï was on the verge of merging with *i at or about the time it figured as a neutral vowel. In SPOKEN MONGOLIAN, the neutral determined vowel is i but also ə as is the determiner vowel. In non-initial unstressed short syllables, all vowels are realized as ə. However,

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[8] These are Ramstedt's symbols. Martin uses i and ə respectively.

although vowels no longer contrast with one another in those environments, original qualities are retained allophonically. Similarly in EASTERN CHEREMIS, all word-final vowels merge with ə which in stem syllables functions as a determiner of unrounded suffix vowels. In FINNISH and HUNGARIAN, in addition to neutral i we find neutral e. As just noted, i is the result of a merger between *i and *ï but neutral e seems to be the product of a slightly different kind of process. Given an early or PRE-URALIC system like the following:

*i ü ï u

e õ o

ä a

*Front	i	e	ü	ä
*Back	i	õ	u	a

with incipient merger of *ï with *i and of *õ with *o, it is clear that *e could no longer participate in harmonic alternations since its "natural partner" had disappeared. Alternatively, this might be accounted for as due to the fact that the vowels of originally alternating pairs were homorganic in terms of rounding. Thus, once unrounded *õ merged with *o, the latter could not alternate with *e.

All well and good, but why -- we might ask -- should a almost invariably serve as the neutral vowel in cases of horizontal harmony and i in cases of palatal harmony? For the former, the evidence points to the natural asymmetry of a in most vowel systems. Where a is symmetrical, there generally is no neutral vowel. Compare, for example, the following horizontal systems without neutral vowels:

ACHOLI

i u

I U

e o

ɛ ɔ

ä a

AKAN

i u

I U

e o

ɛ ʌ ɔ

a

IBO

i u

e U

ɛ o

a ɔ

On the other hand, where a is asymmetrical, it generally functions as a neutral vowel:

MASAI

i u

I U

e o

ɛ ɔ

a

OLD KANNADA

i u

e o

a

Note that this latter situation exactly parallels the products of various mergers in languages with palatal harmony and i, and sometimes e, serving as neutral vowels. As we have seen, they become neutral vowels due to the asymmetry created by merger. Thus, asymmetry between opposing grades would seem to be the key to, or at least a major factor in, the development of neutral vowels. Another reason why i is the neutral vowel par excellence in palatal systems is probably because of the relative instability of the more marked high front rounded and back unrounded vowels which often tend to merge with i.

In view of what we have just said about neutral vowels in horizontal and palatal systems, we would logically expect the typical neutral vowel in labial systems to be u, the least marked of the labial vowels. While the evidence belies this, it is also true that virtually all of it is from one family of languages, TURKIC. In these languages, the typical neutral vowel for labial systems is a. Furthermore, in TURKIC this is largely due to the fact that the low rounded vowels (o, ö) are partisan vowels, as such occurring only after stems containing the same vowels. This means that their potential occurrence after other stem vowels is blocked and they are neutralized to the corresponding low unrounded vowels, a and e, more commonly a although e does occur often enough. We must therefore leave the question of neutral vowels in labial systems open for the present.

6. Conclusions

In this paper, we have examined vowel harmony from the standpoint of those conditions that favor its development, markedness, dimensional types, and neutral vowels.

As regards conditions favoring the development of harmonic systems, we have attempted to show first that there are certain direct relations between the degree of sonority of a vowel or class of vowels and proneness to assimilate, both synchronically and diachronically. Thus, barring other factors, we may expect high vowels to assimilate before low vowels, short before long vowels, less fully voiced before more fully voiced vowels, and unstressed before stressed vowels.

Second, relative contiguity between determiner and determined vowels figures importantly in a number of different ways. Generally speaking, there is a direct relationship between contiguity and the probability that a given vowel may assimilate to another vowel. That is, the closer determiner and determined vowels are to one another, the more likely it is for the latter to assimilate to the former. On the phonological level, in the case of noncontiguity, the nature of the intervening segment(s) is of crucial importance. Thus, the internal gradations of the two major articulatory dimensions for consonants, point and manner of articulation,

may be correlated with two scales of resistance to the pervasion of adjacent vocalic features in case of assimilation of vowel to vowel: posterior consonants offer less resistance than anterior consonants and open consonants (e.g. sonorants) less than close consonants (e.g. stops). On the grammatical level, vowels of more closely bound elements (affixes, particles, pronouns, auxiliaries, pre-and postpositions, etc.) are more likely to assimilate than those of more loosely bound ones, either morphologically or syntactically. Compound elements almost invariably fall into the latter category thus constituting "exceptions" to the rules of vowel harmony in a given language. On the sociolinguistic level, loans from other dialects or languages, being of necessity linguistically more distant from the norms of the speech community represented in native forms, are less likely to exhibit vowel harmony than the latter.

Third, the relative phonetic distance between two corresponding members of potential harmonic grades, i.e. potential alternants in a harmonic system, may be a determining factor in terms of assimilability: the closer the two vowels, the greater the likelihood of assimilation.

Assuming, on the basis of features of stress, pitch, duration and tongue-root position (advanced vs. retracted), that lax vowels are marked and tense unmarked, we find some of these same features associated with the grades of the three primary dimensions of harmonic systems: horizontality, palatality and labiality. Thus, we find for the first dimension that low vowels are unmarked, for the second front vowels, and for the third unrounded vowels. In vowel harmony systems, ceteris paribus, we therefore expect marked feature values to assimilate to unmarked values. Furthermore, among the three primary dimensions there appears to be another markedness hierarchy: labiality is more marked than palatality and palatality is more marked than horizontality.

The fact that a is the typical neutral vowel in horizontal systems corresponding to i in palatal systems may be explained by the natural articulatory asymmetry of a on the one hand and the induced contrastive asymmetry of i, resulting from mergers of generally less stable *ɨ or *ʉ with *i, on the other.

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Abbreviations:

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IL	Indian Linguistics
IUP, U-A	Indiana University Publications, Uralic and Altaic Series
JAL	Journal of African Linguistics
JAOS	Journal of the American Oriental Society
MLN	Modern Language Notes
NTS	Norsk Tidsskrift for Sprogvidenskap
UCPL	University of California Publications in Linguistics
WPLU	Working Papers on Language Universals

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